SEAWEED RESOURCES OF SOUTH AFRICA.

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Precise figures of South African seaweed resources cannot be given since no quantitative surveys have been carried out. Indicative data, however, are available from the records of Vitamin Oils, Ltd., Cape Town. These estimates are based on the amounts of certain species collected at particular localities.

Algin yielding weeds.

Alginic acid can be obtained from *Ecklonia maxima*, South African *Macrocystis*, *Laminaria pallida*, *Bifurcaria brassicaeformis* and *Sargassum longifolium* (Lighthelm, von Holdt and Schumann, unpublished paper). The last named species has the lowest content and is not present in sufficient amount to be of commercial value. The last remark applies also to *Macrocystis*.

As an abundant intertidal species, *Bifurcaria brassicaeformis* has a restricted geographical range, being abundant only between Cape Town and Cape Agulhas (Isaac, 1951). It is not cast up to any extent and thus would have to be cut from the rocks at low water of spring tides.

Laminaria pallida and especially *Ecklonia maxima* are abundant and are cast up in large quantities along certain parts of the west coast. *Ecklonia* is cast up throughout the year and being buoyant because of hollow stipe and float it is cast high up on the shore where most of it remains. *Laminaria* is cast up after heavy storms, mostly in July and

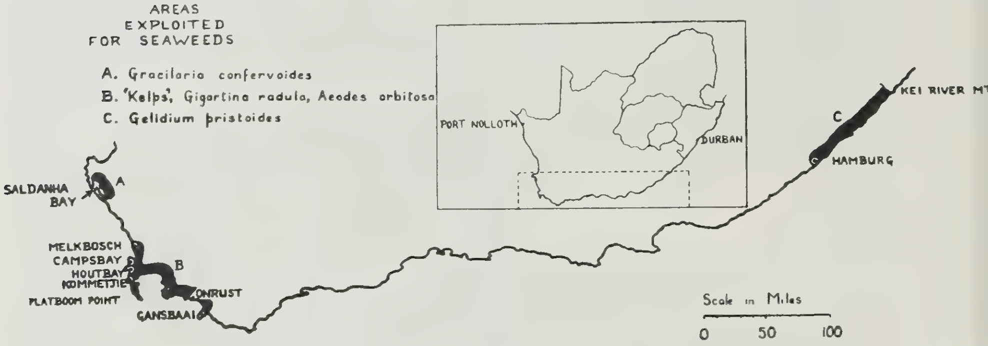

FIG. 1. Map showing areas exploited for seaweeds.

August. Lacking the large internal cavities of *Ecklonia*, it is less buoyant and is cast up lower on the beach, and is removed again to a considerable extent by the outgoing tide. Related to the relatively small seasonal variation in temperature of the colder South African waters in which these kelps grow (Isaac, 1937a, 1937b, 1949) there is no difference in the cast up *Ecklonia* at different times of year corresponding to the May and winter casts of kelp on British coasts (Newton, 1951). Referring to cast up material of *Ecklonia maxima* and *Laminaria pallida*, Shuttleworth (1951, c, p. 115) writes: "A fairly conservative estimate would seem to put the total quantity of these two weeds annually deposited on our coastline after storms, etc., at many hundreds of thousands if not millions of tons." He does not indicate how he arrives at his estimate. Again, there are no critical data on which to base Shuttleworth's assertion that: "Our resources are almost certainly greater than those of Scotland"[1] (*Ibid*, p. 116.) It is clear, however, that there are large quantities of sublittoral kelp westwards from Cape Agulhas. Thus from five localities only (Melkbosch, Kommetje, Plaatboom Point, Onrust and Gansbaai) 6,000 tons dry weight (about 15 per cent. water) of cast up kelp, mostly *Ecklonia*, can be collected annually. These localities (Fig. 1) represent but a small part of the total coastline along which kelps grow but much of the west coast is very inaccessible for the commercial collection of cast up kelp. Also the distances and lack of transport facilities involved would make it uneconomical to convey seaweed from remoter parts of the coast.

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[1] Although available data will not allow of a clear refutation, there can be no doubt that Shuttleworth exaggerates the quantities of kelp on South African coasts.

Agarophytes.

Agar can be obtained from the following species: *Gelidium cartilagineum*, *G. pristoides*, *Gracilaria confervoides* and *Suhria vittata* (Isaac, Finlayson and Simon, 1943). Fox and Stephens (1943) reported agar from these species as well as from *Caulacanthus ustulatus* and *Hypnea spicifera* but their paper contains no details regarding the products extracted. Isaac *et al.* (1943) showed that the *Hypnea spicifera* extractive is not a true agar. It was also reported that the agar extracted from *Gelidium pristoides* was of inferior quaility, but subsequent work at Vitamin Oils, Ltd. has shown that a high quality agar is obtainable from this plant. Agar might be extracted from other South African species, including species of *Gelidium*, but these plants are either too small or not present in sufficient amounts to make them valuable commercially. *Gelidium corneum* was listed for South African coasts by Delf and Michell (1921) and Fox and Stephens (1943) reported that there is some evidence that it may occur on the coasts of the Eastern Province. Papenfuss (1943) refers to a species of *Gelidium* from the east coast of South Africa which "has been referred to *Gelidium corneum* by some authors and to *G. rigidum* (now *Gelidiella acerosa*) by others, but the writer is still uncertain of its identity" (p. 91, footnote 6). Newton (1951, p. 118) wrongly reports Isaac as indicating that *G. corneum* occurs on South African coasts. Thus it is still uncertain whether the species occurs on these coasts and in view of investigations carried out over an extensive range of South African coasts it is clear that it is not a common species.

Caulacanthus ustulatus, *Gelidium cartilagineum* and *Suhria vittata* do not occur in sufficient amounts to be commercial sources of agar. *G. cartilagineum* is a smaller and less luxuriant plant on South African coasts than on Californian coasts and diving operations have shown that it does not extend into the sublittoral in the way that the Californian plant does. On South African coasts it is also frequently found growing alongside the species which has been known here as *G. rigidum*[2] with which it can sometimes be confused by harvesters. *G. rigidum* yields only a small amount of low grade agar. Thus as the picture is at present known, the two commercially important agarophytes are *G. pristoides* and *Gracilaria confervoides*. The latter gives in some respects a relatively inferior agar but has the advantage of being cast up in very large amounts in the Saldanha—Langebaan area. About a thousand tons of dry weed is cast up annually in this region. It occurs also at Hout Bay and at Luderitz but in much smaller amounts. Thus the first area named was, and remains, the source of the commercial seaweed. Originally South African agar was obtained exclusively from this species but since 1951 agar has been obtained commercially from this species and from *Gelidium pristoides*[3]. The latter species is not cast up and has to be picked from mid-tide levels. It is widely distributed on South African coasts in moderately warm waters. It has been collected commercially from Hamburg to Kei River mouth (about 70 miles of coastline) at the rate of about 80 to possibly 100 tons dry weight per annum. Unfortunately no data are at present available regarding its rate of growth and seasonal reproductive cycle although work in regard to the latter is in hand.

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[2] The South African plant known as *Gelidium rigidum* (now *Gelidiella acerosa*; see Papenfuss, 1943) seems to be *Gelidium amansii*. (Papenfuss, 1951).

The full story of South African *Gracilaria confervoides* has not been elucidated but Shuttleworth's account is not correct. Shuttleworth (1951b) seems to assume that the account given for North Carolina material (Causey *et al.*, 1946) is true for South African *Gracilaria* but this is not so. Apart from cast up weed this plant occurs at Saldanha—Langebaan floating in the water and on sand banks where it is weighted down by sand or entangled with mussels. A fuller account will be published later but the chief results obtained are indicated below:

(*a*) Only small amounts of attached plants have been found[4].

(*b*) Freshly cast up material, sandbank material and floating material will grow vegetatively in frequently changed sea water in the laboratory.

(*c*) Fertile as well as sterile material is used for agar manufacture.

It may be noted that only sterile plants of *Gracilaria confervoides* are used for the manufacture of agar in eastern U.S.A. (Causey *et al.*, 1946).

Species yielding phycocolloids other than Alginic acid and Agar.

The chief South African sources of phycocolloids other than alginic acid and agar at present known are *Aeodes orbitosa*, *Gigartina radula* and *Hypnea spicifera*. The properties of *Hypnea spicifera* extractive have been discussed by Shuttleworth (1951a) and the distribution of this abundant South African seaweed has been outlined by Isaac and Hewitt (1953). More research, however, needs to be carried out on the extractive and the technology of extraction.

Aeodes orbitosa is found in cold and moderately cold water. It occurs in the lower parts of the mid-tidal level. It is often a relatively small plant but it may attain lengths of 2—3 feet. In some localities (Melkbosch, Kommetje, Camps Bay, Gansbaai) it is a common or abundant species.

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[3] For reasons not connected with the quality of the agar, this species is not being harvested at present.

[4] No attached plant or basal attaching disc had been found when this paper was presented in July, 1952.

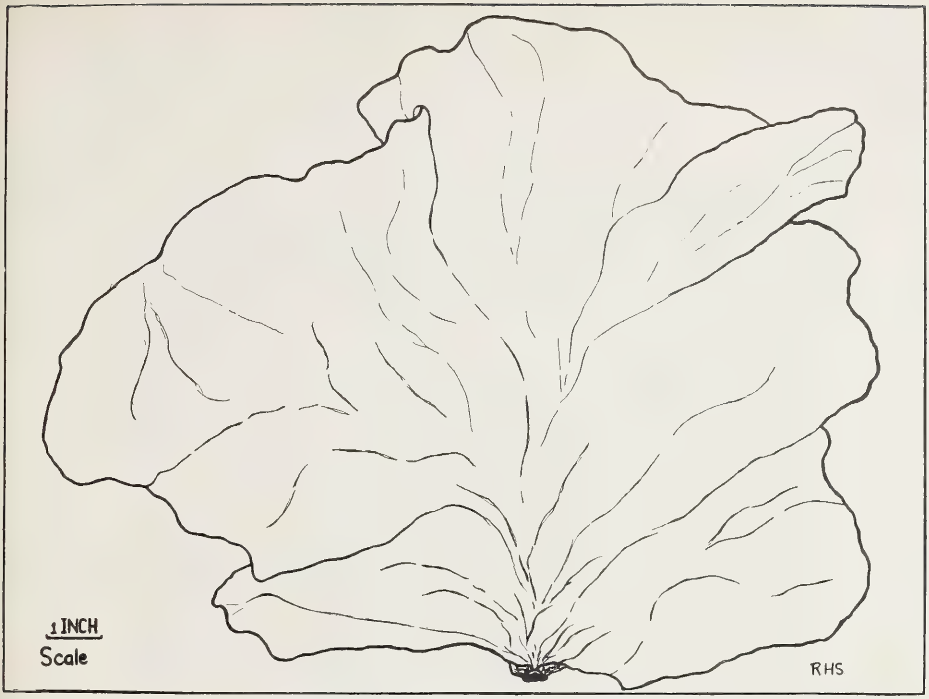

FIG. 2 A. *Aeodes orbitosa* showing holdfast.

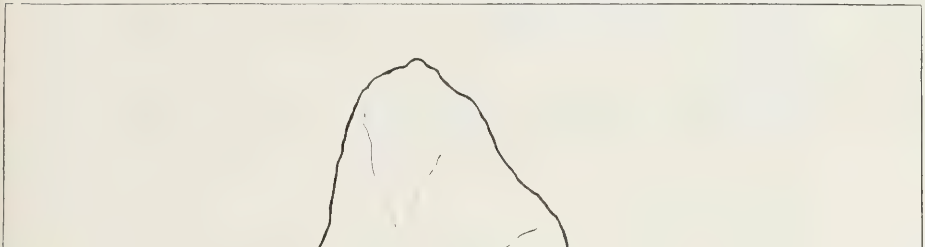

FIG. 2 B. *Iridophycus capensis* showing holdfast and stipe.

Its general appearance is similar to that of *Iridophycus capensis*, which seems to have a similar vertical and geographical distribution. *Iridophycus* tends to be darker in colour and does not grow to the maximum dimensions attained by *Aeodes orbitosa*. The two plants can be distinguished by their basal parts. *Aeodes orbitosa* has a simple, relatively large and strong holdfast so that the plant is not easily detached from the rock (Fig. 2A). *Iridophycus* has a smaller holdfast which in general grips the rock less firmly and it also has a more or less distinct short stipe which is more or less distinctly canaliculated (Fig. 2 B). A stipe is completely absent in *Aeodes*. Except locally, *Aeodes* is much more abundant than *Iridophycus*. More information, however, is needed on the ecology of these two plants. *Aeodes* has been used successfully for copper fining of beer but it is not sufficiently abundant to be of industrial importance.

Dried *Gigartina radula* is also excellent material for beer fining and has already been exported for this purpose. It occurs at lower intertidal levels in places where the coast is sheltered from the full force of the sea and is found on the west coast and in localities as far east as Danger Point. Although it may be absent on many parts of the coast where the seaweeds are exposed to rough seas, it is common in other places. An indication of its abundance is afforded by the claim that up to 100 tons dry weight (20—30 per cent. water) per annum can be obtained from the Peninsula coasts.

Miscellaneous.

The possible use of South African seaweeds as food and as fertilizer was discussed in a previous paper (Isaac, 1942).

Concluding Remarks.

An attempt has been made to give an indication of seaweed resources available for industry in South Africa. More exact surveys are clearly required to give a fuller picture. Where estimates have been given they have been conservative. Fig. 1 helps to put the matter into perspective since it makes clear that only a small part of the total extent of coastline has been exploited for seaweeds. From the data presented it is obvious that considerably more seaweed would be available by collecting over a greater extent of coastline.

Information is needed, however, not only of the amounts available at any given time but also of the rates of growth since it is possible that growth rates will be higher for example than those of British seaweeds. Further, where attached seaweed is harvested, information relating to the annual reproductive cycle is essential if exploitation is to be on a conservation basis.

SUMMARY.

Precise information cannot be given of the seaweed resources of South Africa as no quantitative surveys have been made. Indicative information, however, is available from commercial records of amounts of certain species collected and from known distribution and ecological status of the seaweeds concerned.

The coastline of South Africa is very extensive and only small stretches of it are at present being exploited. The long distances and lack of adequate transport facilities make the exploitation of more inaccessible parts of the coast uneconomical. A further consideration that must be stressed is that more information regarding growth rates and a knowledge of the seasonal reproductive cycles of the exploited species are necessary if exploitation is to be on a sound conservation basis.

Of the algin yielding species large quantities of *Laminaria pallida* and *Ecklonia maxima* are available, especially of the latter which is cast up throughout the year. In five localities only, 6,000 tons dry weight of cast up kelps can be collected annually.

Gracilaria confervoides is a commercially important agarophyte. About 1,000 tons dry weight of the species is cast up annually in the Langebaan —Saldanha area. *Gelidium pristoides* is also possibly a commercially important agarophyte. There is no clear evidence of *Gelidium corneum* on South African coasts.

Aeodes orbitosa and *Gigartina radula* have been successfully used in the copper fining of beer and the latter species has been exported for this purpose. These species are not present in large amounts.

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